In the Claims

Applicant has submitted a new complete claim set showing amended claims with insertions indicated by underlining and deletions indicated by strikeouts and/or double bracketing.

1 2 3 4 6 7 8 9 10

Please amend pending claims 3, 4, 6-9, 11, 15, 16, 21, 23, 25-31, 33 and 37-42 as noted below.

Please add new claims 43-49.

1. (Previously presented) A receiver, for use in an OFDM transmission system, having an adaptive channel equalizer means, a sampling clock and a sampling clock control means wherein ambiguity prevention means are provided to prevent said adaptive channel equalizer means from operating on time differences which should be corrected by operation of said sampling clock control means.

2. (Previously presented) A receiver, as claimed in claim 1, wherein said sampling clock is controlled by data derived from an equalized data stream.

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3. (Currently amended) A receiver, as claimed in claim 1, wherein sampling time deviations in said OFDM system cause received frame argument functions to have a linear slope and ~~in that~~ wherein said sampling clock is controlled using an estimate of said frame argument functions' slope.

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4. (Currently amended) A receiver, as claimed in claim 1, wherein said adaptive channel equalizer means is prevented from operating on said time differences by forcing ~~the~~ a slope of a linear part of an equalizer parameter argument function to be always zero.

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5. (Previously presented) A receiver, as claimed in claim 4, wherein said sampling clock's frequency is controlled by a feed-back signal generated from an estimated slope of an argument function, Y'.U which is the element-by-element product of an equalizer output vector

U and the conjugate of a quantized vector Y derived from an output of a detector means operating on U.

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6. (Currently amended) A receiver, as claimed in ~~either~~ claim 4, wherein ~~a~~ the slope of said equalizer parameter argument function is derived by taking an average slope of the equalizer parameter argument function by unwrapping said equalizer parameter argument function and deriving said average slope from said unwrapped equalizer parameter argument function.

7. (Currently amended) A receiver, as claimed in claim 6, wherein the average slope α_k of the linear part of the equalizer parameter argument function is calculated from:

$$\alpha_k = \frac{1}{N}\sum_n \frac{\angle EQ_{n,k}}{n} \qquad (1a)$$

B2 Cont.

where $\angle EQ$ is an unwrapped equalizer parameter argument function, n is a carrier index, k is ~~the~~ a frame number and N is ~~the~~ a size of ~~the~~ a frequency domain frame.

8. (Currently amended) A receiver, as claimed in claim 6, wherein the average slope ~~ak~~ α_k of the linear part of the equalizer parameter argument function is calculated from:

$$\alpha_k = \frac{2}{n_2 - n_0}\left(\sum_{n=n_1=1}^{n_2} \angle EQn,k - \sum_{n=n_0}^{n_1} \angle EQ_{n,k}\right) \qquad (1b)$$

where $\angle EQ$ is an unwrapped equalizer parameter argument function, n is a carrier index, k is a frame number, N is a size of a frequency domain frame, [[n,]] n_1 divides a received frequency band into two equal parts and n_0, and n_2 are lower and upper limits, respectively, of the frequency band.

B2 Concl.

9. (Currently amended) A receiver, as claimed in claim 8, wherein, where several separate frequency bands are present in the received signal, equation ~~1(b)~~ (1b) is applied to each frequency band separately and the average of the results employed as the slope of the equalizer parameter argument function.

10. (Previously presented) A receiver, as claimed in claim 5, wherein said equalizer parameter argument function is rotated in small steps until said slope is zero.

11. (Currently amended) A receiver, as claimed in claim 10, wherein said rotation is performed by using a vector L of complex numbers with unit magnitude and a linear argument function with a slope equal to a small fraction α_k, and ~~in that~~ wherein L is calculated from:

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$$L_{n,k} = \exp(-j.\beta.\frac{n}{N}.\alpha_k) \tag{2}$$

where β controls the speed of adaptation to the zero slope.

12. (Previously presented) A receiver, as claimed in claim 5, wherein an equalizer parameter vector EQ is adaptively updated using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_1 . \frac{X^{\bullet}_{n,k}}{\left| X_{n,k} \right|^2} .(Y_{n,k} - U_{n,k}) \right] . L_{n,k} \tag{3a}$$

13. (Previously presented) A receiver, as claimed in claim 5, wherein an equaliser parameter vector EQ is adaptively updated using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_2 . \frac{X^{\bullet}_{n,k}}{\left| X_{n,k} \right|} .(Y_{n,k} - U_{n,k}) \right] . L_{n,k} \tag{3b}$$

14. (Previously presented) A receiver, as claimed in claim 5, wherein an equaliser parameter vector EQ is adaptively updated using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_3 . X^{*}{}_{n,k} . (Y_{n,k})\right] L_{n,k} \qquad (3c)$$

15. (Currently amended) A receiver, as claimed in claim 12, wherein the algorithm definedby equation ~~3(a)~~ (3a) is employed during a start up sequence for said receiver.

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16. (Currently amended) A receiver, as claimed in claim 13, wherein the algorithm defined by equation ~~3(c)~~ (3c) is used for tracking slow changes in the adaptive equaliser parameter vector EQ subsequent to a start up sequence for said receiver.

17. (Previously presented) A receiver, as claimed in claim 1, wherein said OFDM system employs DMT.

18. (Previously presented) A receiver, as claimed in claim 1, wherein said OFDM system is an ADSL system.

19. (Previously presented) A receiver, as claimed in claim 1, wherein said OFDM system is a VDSL system.

20. (Previously presented) A receiver, as claimed in claim 1, wherein said OFDM system is a mobile telecommunications system.

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21. (Currently amended) An OFDM multi-carrier transmission system having at least one transmitter and a plurality of receivers, wherein said receivers are receivers as claimed in ~~any of claims 1 to 20~~ claim 1.

22. (Previously presented) A transceiver, for use in an OFDM transmission system, wherein said transceiver includes a receiver as claimed in claim 1.

23. (Currently amended) In an OFDM transmission system having a transmitter and a receiver, said receiver having an adaptive channel equalizer means, a sampling clock and a sampling clock control means, and said transmitter having a sampling clock, a method of maintaining synchronizations between said receiver sampling clock and said transmitter sampling clock, wherein said adaptive channel equalizer means is prevented from operating on time differences which should be corrected by operation of said sampling clock control means.

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24. (Previously presented) A method, as claimed in claim 23, comprising controlling said sampling clock with data derived from an equalized data stream.

25. (Currently amended) A method, as claimed claim 23, comprising sampling time deviations in said OFDM system causing received frame argument functions to have a linear slope and ~~by~~ controlling said sampling clock using an estimate of said frame argument functions' slope.

26. (Currently amended) A method, as claimed in claim 23, comprising preventing said adaptive channel equalizer means from operating on said time differences by forcing ~~the~~ a slope of a linear part of an equalizer parameter argument function to be always zero.

B7 Cont.

27. (Currently amended) A method, as claimed in claim 26, comprising ~~by~~ controlling said sampling clock's frequency with a feed-back signal generated from an estimated slope of an argument function, $Y^*.U$ which is the element-by-element product of an equalizer output vector U and the conjugate of a quantized vector Y derived from an output of a detector means operating on U.

28. (Currently amended) A method, as claimed in claim 26, comprising deriving ~~a~~ the slope of said equalizer parameter argument function by taking an average slope of the equalizer parameter argument function by unwrapping said equalizer parameter argument

function and deriving said average slope ~~torn~~ from said unwrapped equalizer parameter argument function.

29. (Currently amended) A method, as claimed in claim 28, comprising calculating the average slope α_k of the linear part of the equalizer parameter argument function from:

$$\alpha_k = \frac{1}{N}\sum_n \frac{\angle EQ_{n,k}}{n} \qquad (1a)$$

where $\angle EQ$ is the unwrapped equalizer parameter argument function, n is ~~the~~ a carrier index, k is ~~the~~ a frame number and N is ~~the~~ a size of ~~the~~ a frequency domain frame.

B7 Cond.

30. (Currently amended) A method, as claimed in claim 28, comprising calculating the average slope α_k of the linear part of the equalizer parameter argument function from:

$$\alpha_k = \frac{2}{n_2 - n_0}\left(\sum_{n=n_1=1}^{n_2} \angle EQn,k - \sum_{n=n_0}^{n_1} \angle EQ_{n,k}\right) \qquad (1b)$$

where $\angle$EQ is the unwrapped equalizer parameter argument function, n is ~~the~~ a carrier index, k is ~~he~~ a frame number, N is ~~the~~ a size of ~~the~~ a frequency domain frame, [[n,]] n_1 divides the received frequency band into two equal parts and n_0 and n_2 are lower and upper limits, respectively, of the frequency band.

31. (Currently amended) A method, as claimed in claim 30, comprising, where several separate frequency bands are present in the received signal, applying equation ~~1 (b)~~ (1b) to each frequency band separately and employing the average of the results ~~employed~~ as the slope of the equalizer parameter argument function.

32. (Previously presented) A method, as claimed in claim 27, comprising rotating said equalizer parameter argument function in small steps until said slope is zero.

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33. (Currently amended) A method. as claimed in claim 32, comprising performing said rotation by using a vector L of complex numbers with unit magnitude and a linear argument function with a slope equal to a small fraction a, and ~~in that~~ calculating L ~~is calculated~~ from:

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$$L_{n,k} = \exp(-j.\beta.\frac{n}{N}.\alpha_k) \qquad (2)$$

where β controls the speed of adaptation to the zero slope.

34. (Previously presented) A method, as claimed in claim 27, comprising adaptively updating an equaliser parameter vector EQ using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_1 . \frac{X^{\bullet}{}_{n,k}}{\left|X_{n,k}\right|^2} . (Y_{n,k} - U_{n,k}) \right] . L_{n,k} \qquad (3a)$$

35. (Previously presented) A method, as claimed in claim 27, comprising adaptively updating an equaliser parameter vector EQ using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_2 . \frac{X^{\bullet}{}_{n,k}}{\left|X_{n,k}\right|} . (Y_{n,k} - U_{n,k}) \right] . L_{n,k} \qquad (3b)$$

36. (Previously presented) A method, as claimed in claim 27, comprising adaptively updating an equaliser parameter vector EQ using an algorithm defined by:

$$EQ_{n,k+1} = \left[EQ_{n,k} + \mu_3 . X^{\bullet}{}_{n,k} . (Y_{n,k}) \right] L_{n,k} \qquad (3c)$$

37. (Currently amended) A method, as claimed in claim 34, comprising by employing the algorithm defined by equation ~~3(a)~~ (3a) during a start up sequence for said receiver.

B9 cont.

38. (Currently amended) A method, as claimed in claim 34 comprising using the algorithm defined by equation ~~3(c)~~ (3c) for tracking slow changes in the adaptive equaliser parameter vector EQ subsequent to a ~~tat~~ start up sequence for said receiver.

39. (Currently amended) A method, as claimed in claim 23, wherein said OFDM system ~~employing~~ employs DMT.

B9 Concl.

40. (Currently amended) A method, as claimed in claim 23, wherein said OFDM system ~~being~~ is an ADSL system.

41. (Currently amended) A method, as claimed in claim 23, wherein said OFDM system ~~being~~ is a VDSL system.

42. (Currently amended) A method, as claimed claim 23, wherein said ~~QFDM~~ OFDM system is a mobile telecommunications system.

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43. (New) A receiver for use in OFDM transmission system, comprising:

an adaptive channel equalizer for receiving frequency domain input data and producing an equalized signal;

a detector for quantizing the equalized signal and producing a quantized signal;

a sampling clock;

a sampling clock controller for controlling the sampling clock in response to the equalized signal and the quantized signal; and

an equalization controller for controlling the adaptive channel equalizer in response to the frequency domain input data, the equalized signal and the quantized signal, the equalization controller including an ambiguity prevention mechanism for preventing the adaptive channel equalizer from operating on time differences which are corrected by operation of the sampling clock controller.

B10 Cont.

44. (New) A receiver a defined in claim 43, wherein the adaptive channel equalizer is prevented from operating on the time differences by forcing a linear part of an equalizer parameter argument function to be zero.

45. (New) A receiver as defined in claim 44, wherein the slope of the equalizer parameter argument function is derived by taking an average slope of the equalizer parameter

argument function by unwrapping the equalizer parameter argument function and deriving the average slope from the unwrapped equalizer parameter argument function.

46. (New) In an OFDM transmission system having a transmitter and a receiver, the receiver including adaptive channel equalizer, a sampling clock and a sampling clock controller, and the transmitter including a sampling clock, a method of maintaining sychronization between the receiver sampling clock and the transmitter sampling clock, comprising;

preventing the adaptive channel equalizer from operating on time differences which are corrected by operation of the sampling clock controller.

47. (New) A method as defined in claim 46, comprising preventing the adaptive channel equalizer from operating on the time differences by forcing the slope of a linear part of an equalizer parameter argument function to be zero.

B10 cont.

48. (New) A method as defined in claim 47, comprising deriving a slope of the equalizer parameter argument function by taking an average slope of the equalizer argument function by unwrapping the equalizer parameter argument function and deriving the average slope from the unwrapped equalizer parameter argument function.

49. (New) A method for use in an OFDM transmission system, comprising;

receiving frequency domain input data and producing an equalized signal;

quantizing the equalized signal and producing a quantized signal;

controlling a sampling clock in response to the equalized signal and the quantized signal; and

controlling an adaptive channel equalizer in response to the frequency domain input data, the equalized signal and the quantized signal, including preventing the adaptive channel equalizer from operating on time differences which are corrected by controlling the sampling clock.